JOURNEES D'ETUDES

"TIGHT & SHALE RESERVOIRS"

17-18 Septembre 2013
Sheraton, Alger

Shale Plays Identification and Quantification Challenges and Opportunities in North Africa

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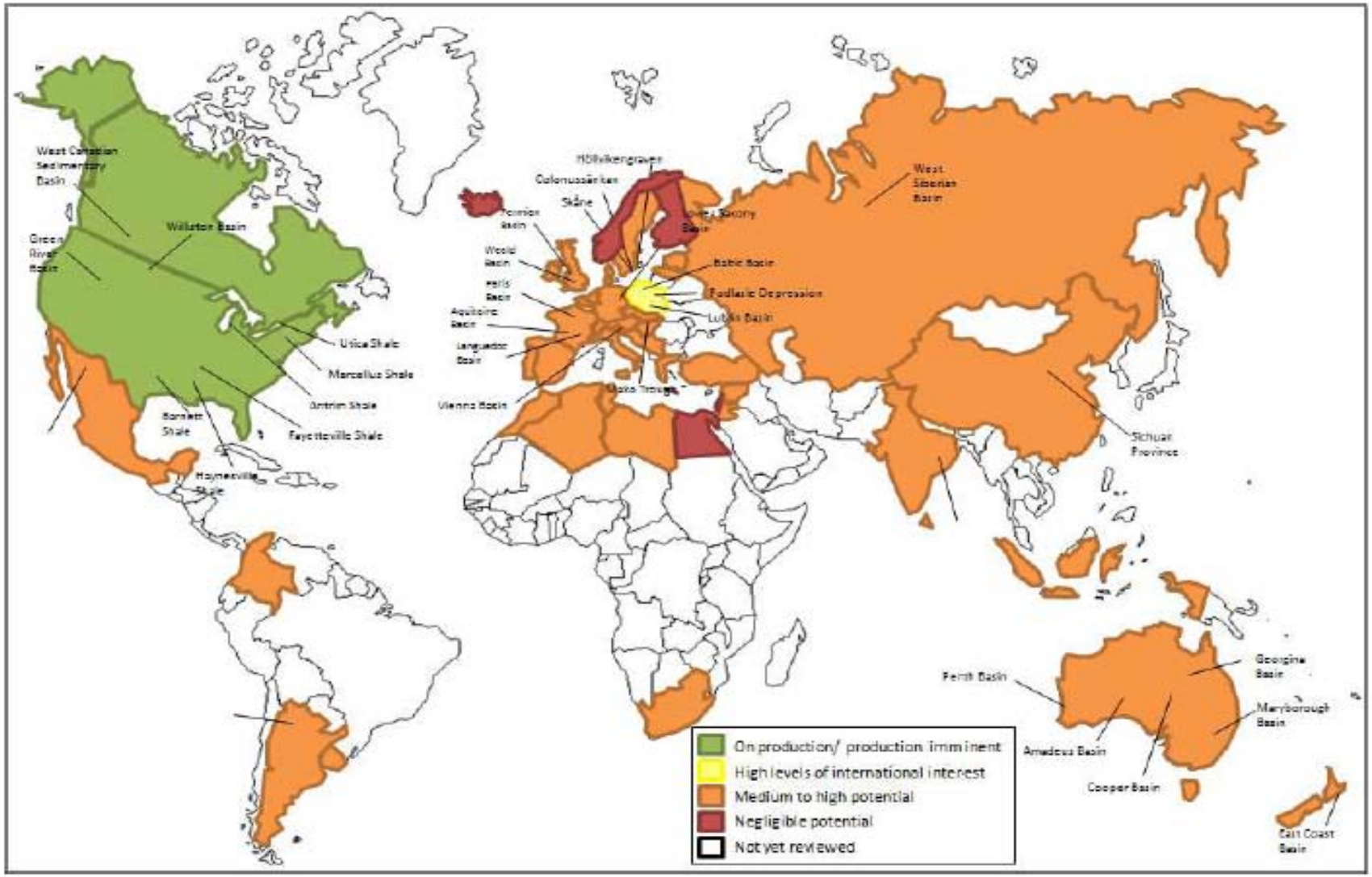
ORGANISME : HALLIBURTON

Outline

- The Accuracy of North Africa shale plays' reserve numbers published by consulting firms and others !!
  - Live example from Egypt .. interesting story
- Methods and data required for identification and quantification of shale plays
- Challenges in shale plays developments and solutions
- Conclusions

Flying Information – April 2010



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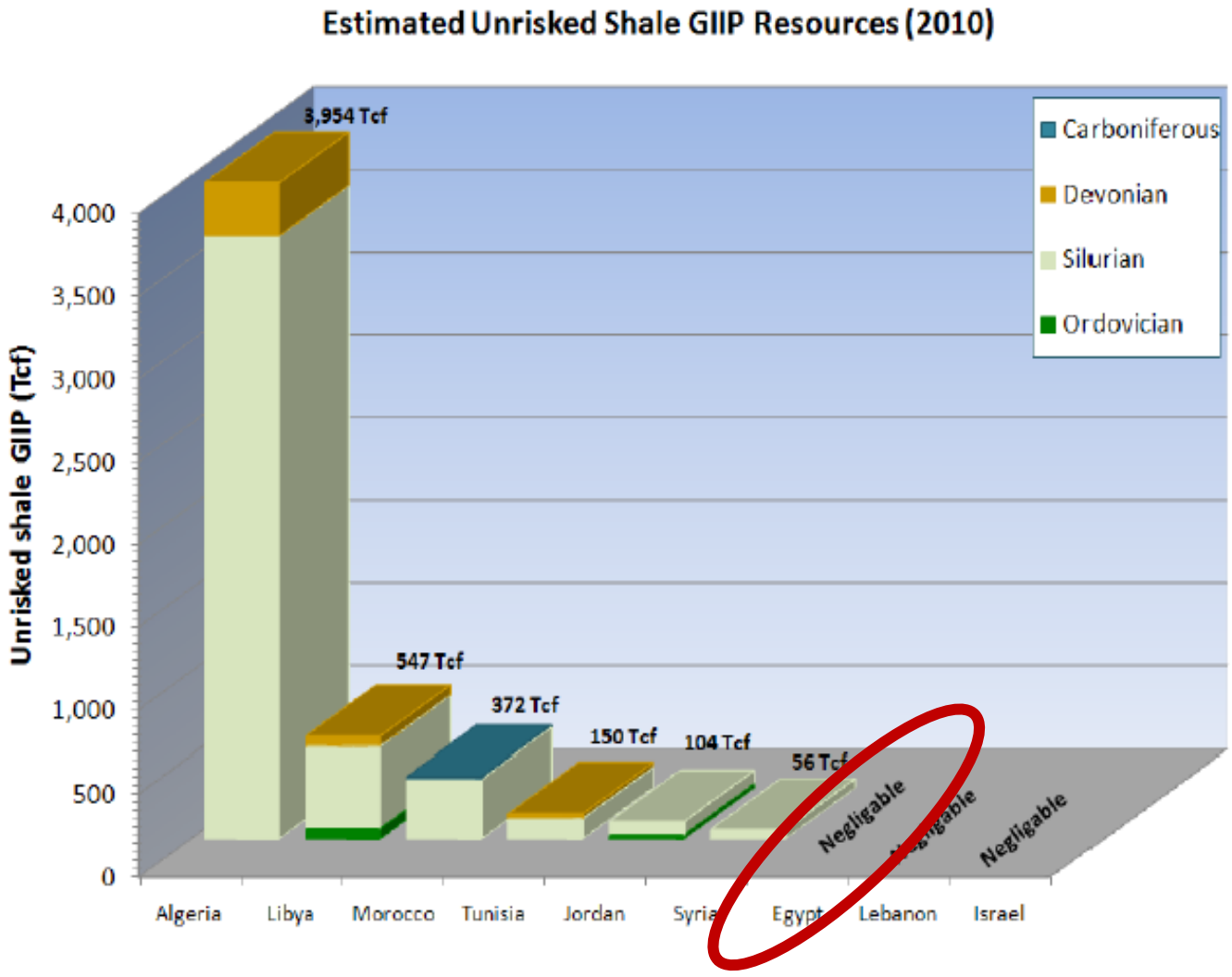
Reserve Numbers Published on 2010



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Developed Process of Investigation

- A technical committee was formed from the Ministry, EGPC and Halliburton
- The committee reviewed all published data during the last 10 years regarding Egypt shale plays estimates specially shale gas
- Evaluate available data and acquire other data as needed.
- Ensure NO disruption of conventional operation
  - Well selection criteria
- The committee discovered the mistake that all published data went through

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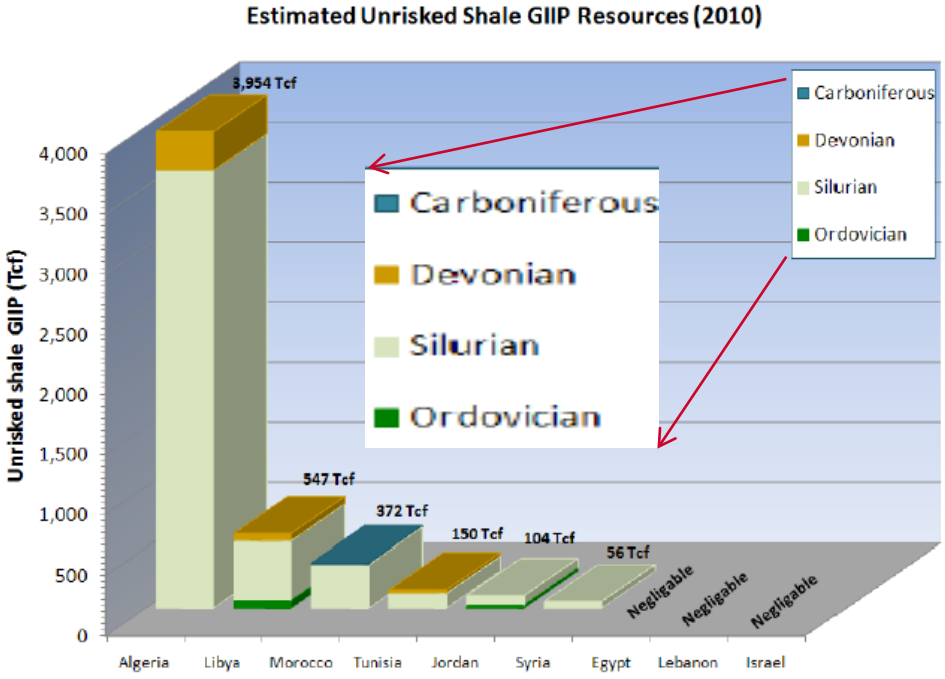
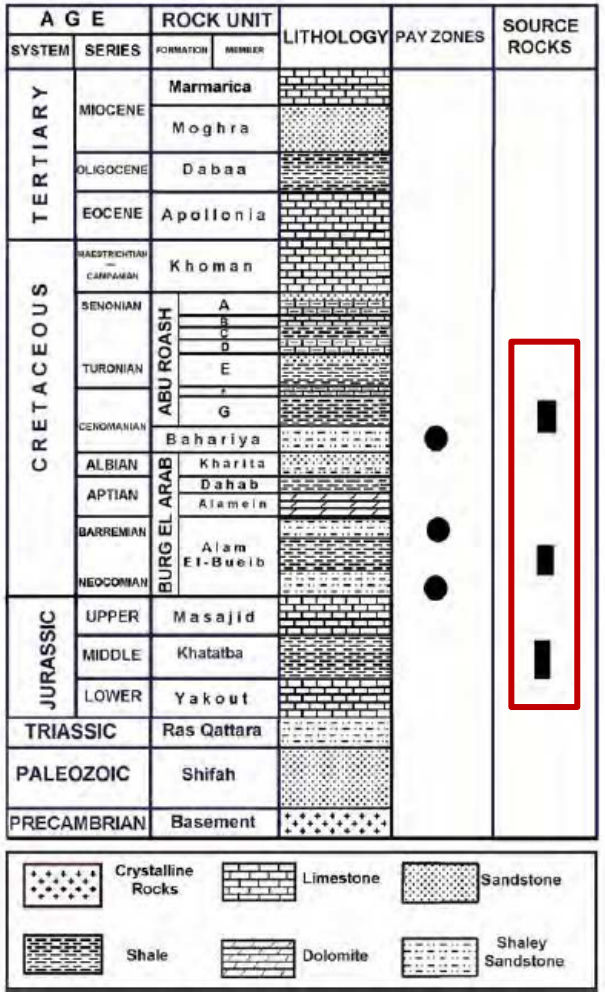
The Finding

It is a mistake to evaluate all North Africa countries on the same scale of geological ages





It is simply that Egypt source rock is in two different geological ages

1. Jurassic
2. Cretaceous

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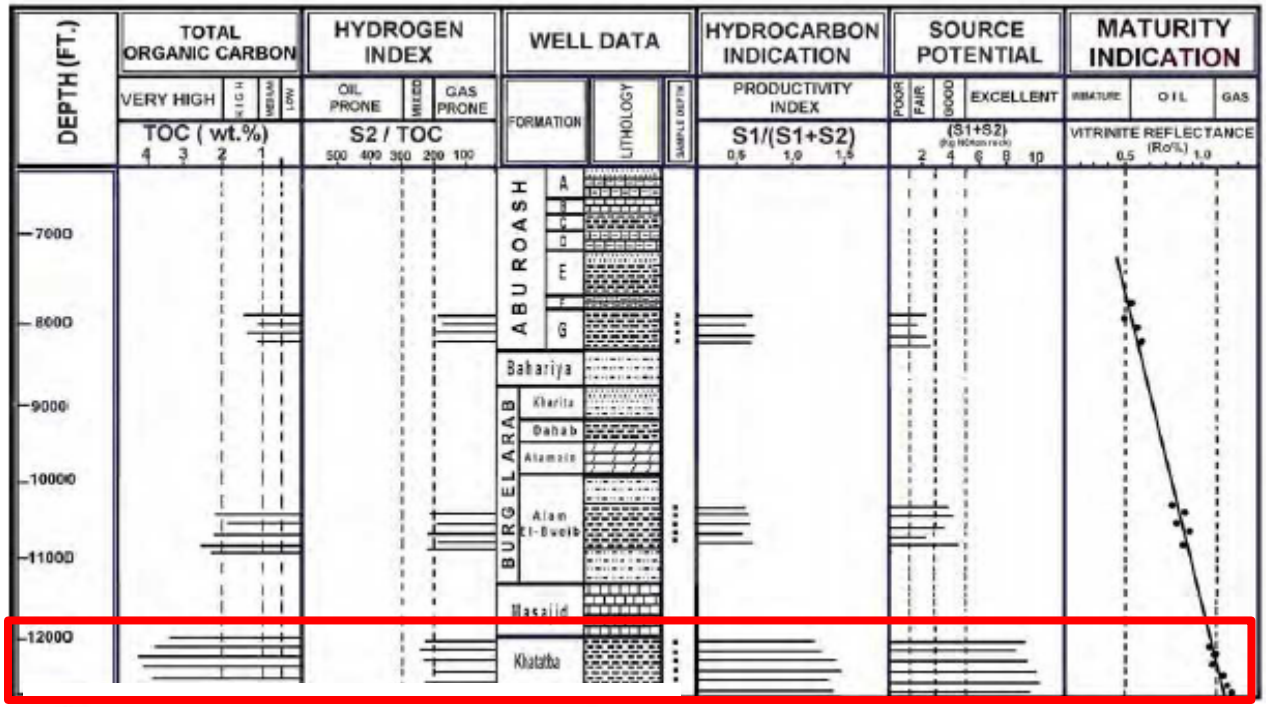
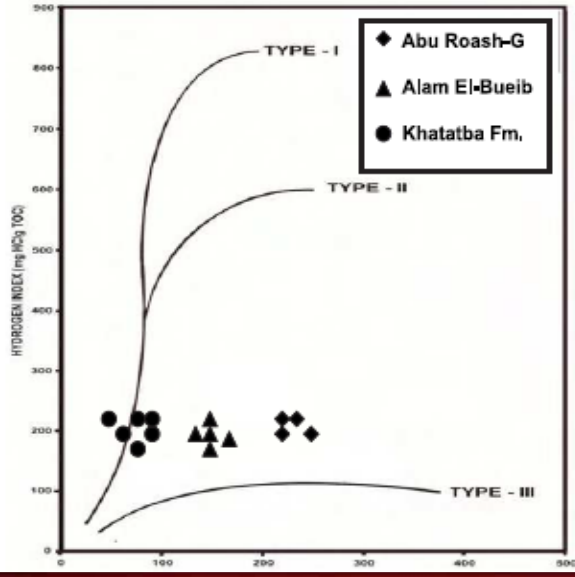
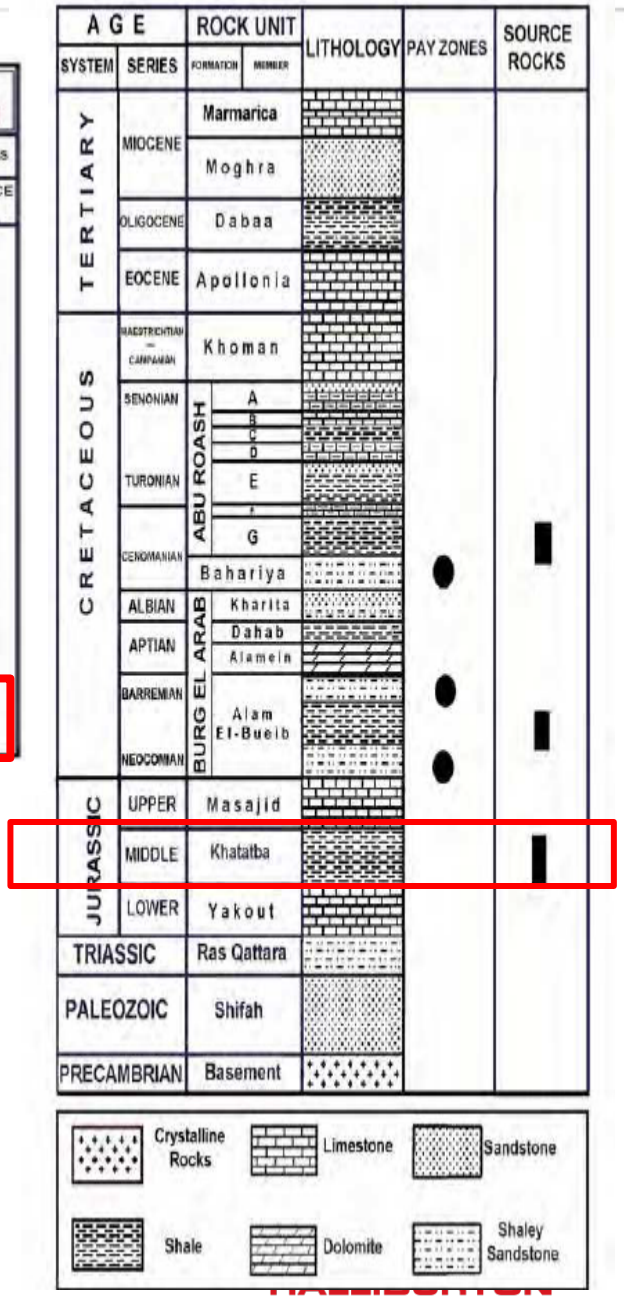
The Finding - Continue





Properties

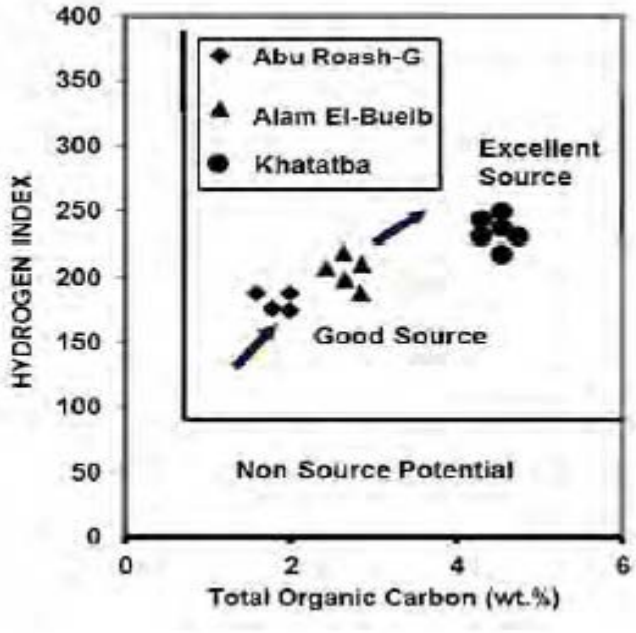
TOC : 2-4 %
VR : 0.9-1.1

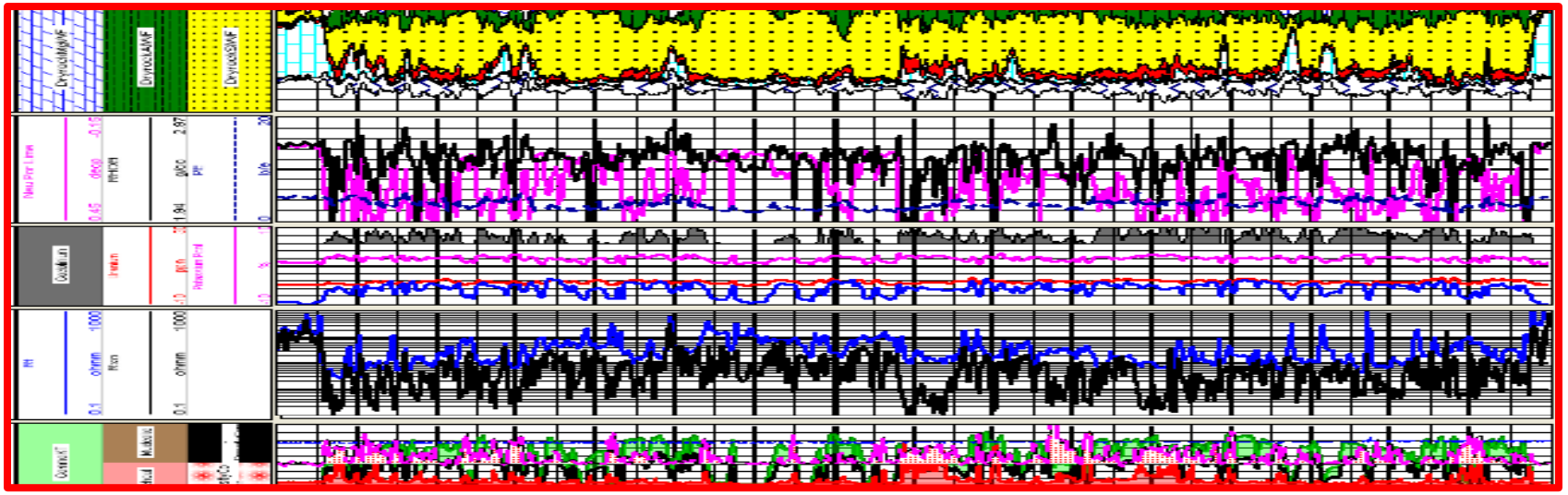


Source Rock – Evaluation Outcome

Well	Total Interval	Net
1	810	360
2	1090	395
3	680	205
4	480	70
5	254	66
6	387	92

Well	Depth	TOC%
2	**xx530 - xx540** **xx590 - xx600**	**3.03** **4.11**
3	**xx640 - xx650**	**12.94**
4	**xx410 - xx420**	**1.2%**





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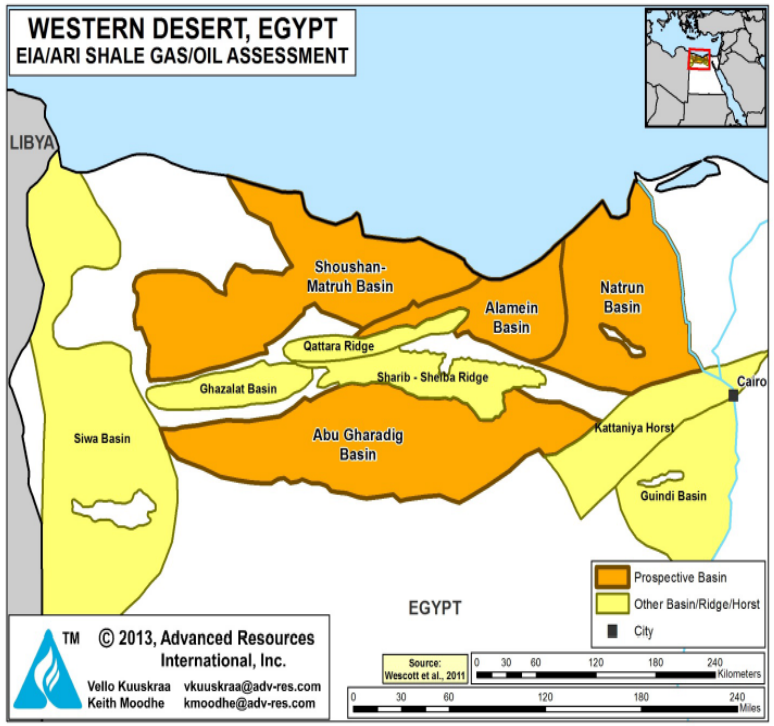
The Surprise: EIA / ARI Report, May 17th 2013

- Our assessment is that the Khatatba Shale contains approximately
  - 535 Tcf of risked shale gas in-place, with 100 Tcf of technically recoverable shale gas resources
  - 114 billion barrels of risked shale oil in-place, with 4.6 billion barrels of technically recoverable shale oil resources

Figure XVIII-1. Hydrocarbon Basins of the Western Desert, Egypt



Source: ARI, 2013.

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EIA – ARI Egypt Shale Gas and Shale Oil Resources, May 17th 2013

			Abu Gharadig	Alamain	Natrun	Shoushan - Matruh
Basic Data	Basin / Gross Area		Abu Gharadig	Alamain	Natrun	Shoushan - Matruh
	Shale Formation		Khatatba	Khatatba	Khatatba	Khatatba
	Geologic Age		M. Jurassic	M. Jurassic	M. Jurassic	M. Jurassic
	Depositional Environment		Marine	Marine	Marine	Marine
Physical Extent	Prospective Area (mi2)		6840	2340	4960	4420
	Thickness (ft)	Rich	1500	1000	1200	1000
		Net	300	200	240	200
	Depth (ft)	Interval	11,000 – 13,000	13000-15000	13000 - 15000	10000 – 15000
		Average	12000	14000	14000	13000
Reservoir Properties	Reservoir Pressure		Normal	Normal	Normal	Normal
	Average TOC (wt. %)		4.0%	4.0%	4.0%	4.0%
	Thermal Maturity (% Ro)		1.15%	0.85%	0.85%	1.15%
	Clay Content		Low / Med	Low - Med	Low - Med	Low - Med
Resources	Gas Phase		Wet Gas	Assoc. Gas	Assoc. Gas	Wet Gas
	GIP Concentration		99.2	29.1	35.0	82.7
	Risked GIP (Tcf)		375.7	16.7	41.6	310.8
	Risked Recoverable (Tcf)		65.1	1.3	3.3	62.2

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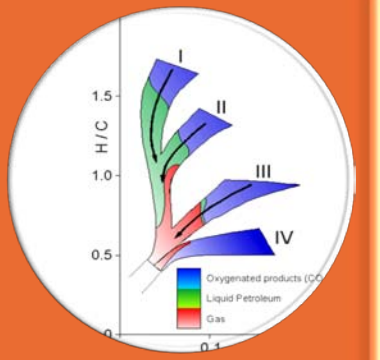
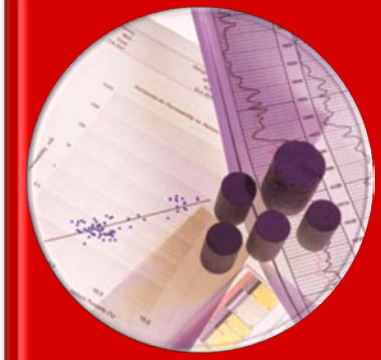
Back to the Evaluation Process – The Components



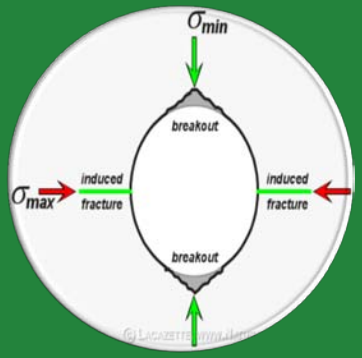
Geo-Chemistry

- TOC,
- Kerogen,
- Maturity ..etc



Formation Evaluation

- Mineralogy
- Porosity, permeability
- Fluid Characterization (typing, saturation …etc)



Geo-Mechanics

- Mechanical Properties
- Stress Field
- Frac. Parameters

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Evaluation of Available Coring and Cuttings is a must

- Features
  - Total Organic Carbon, Pyrolysis maturity
  - XRD, XRF Minerology wt%
  - GRI Porosity & Perm (commercial lab)
  - Sorption-Desorption Isotherms (commercial lab)
  - Brinnell Hardness
  - Stress Testing & Calibration
  - Acid Solubility
  - CST - Capillary Suction Time
- Sources
  - Full Core, Rotary Cores, Percussion Cores
  - Preserved Mud Logged Cuttings

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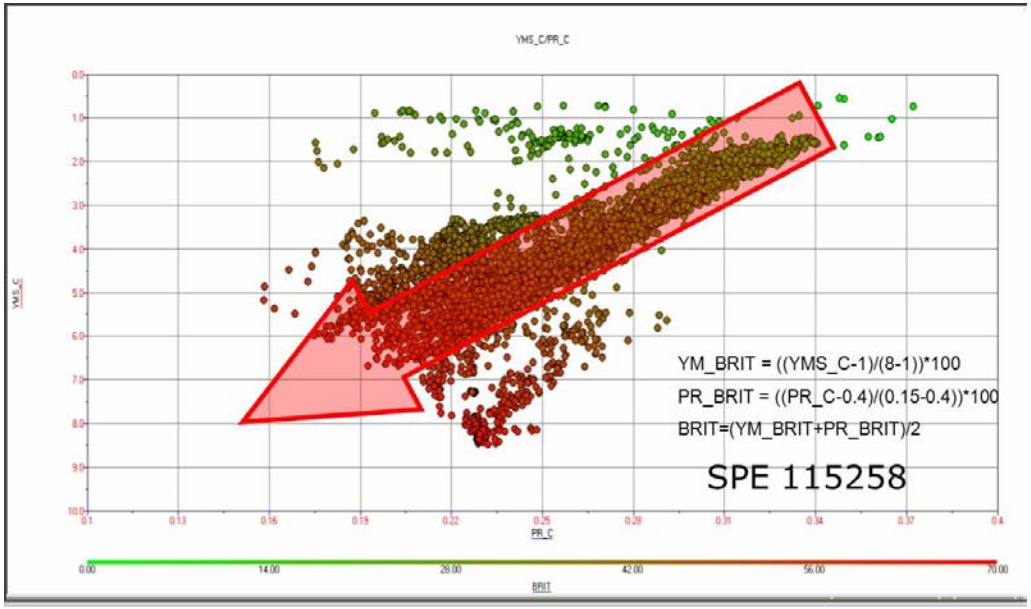
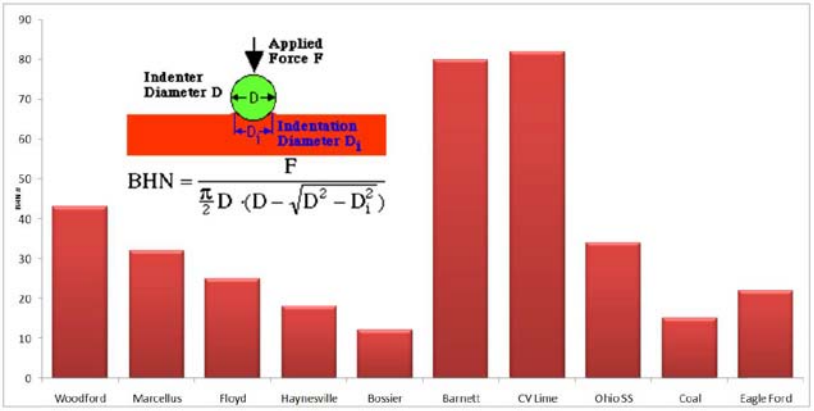
Rock Mechanical Properties and Brittleness

Brittle = Higher YM, Lower PR
Ductile = Lower YM, Higher PR





Core Brinell Hardness

Brittle = High Brinell Hardness
Ductile = Low Brinell Hardness

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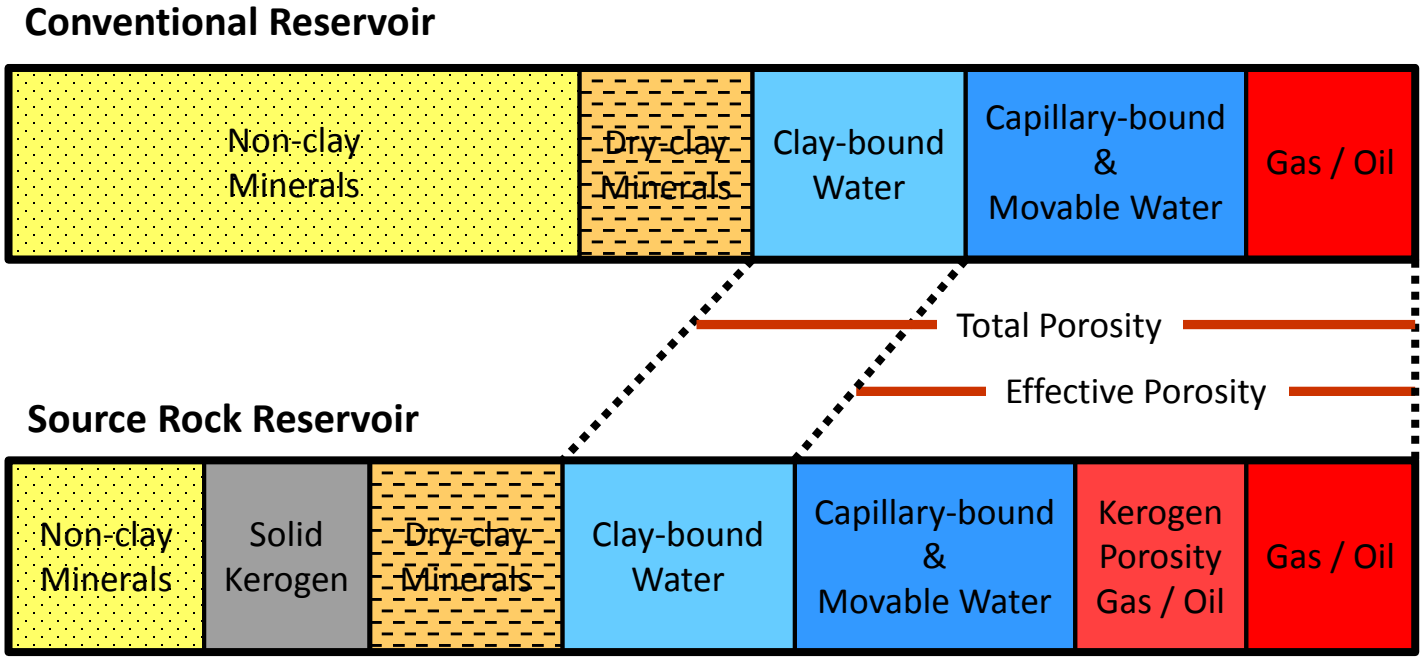
Expand the Rock Porosity Model – Kerogen Porosity



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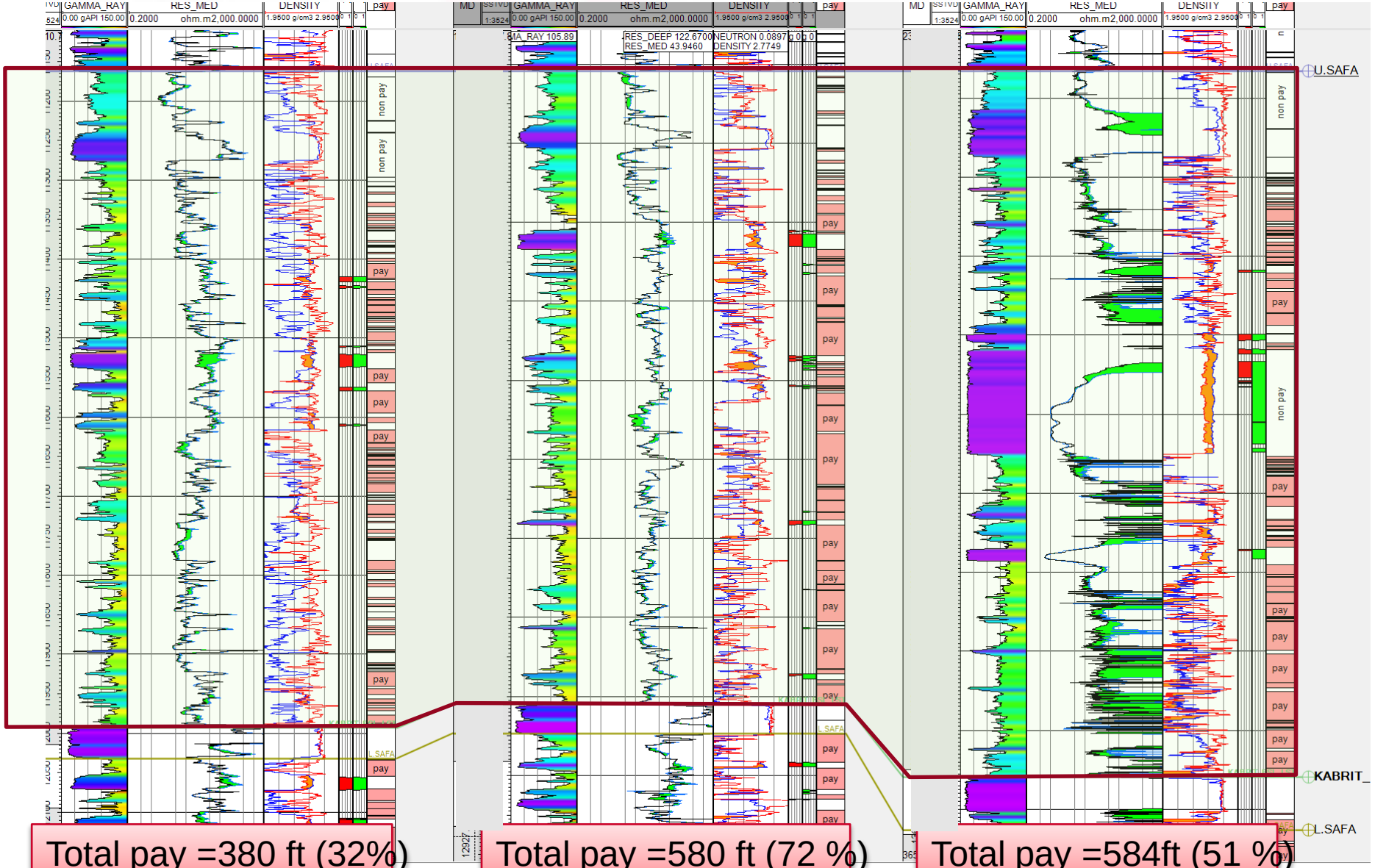
Build Stratigraphic Correlations between wells



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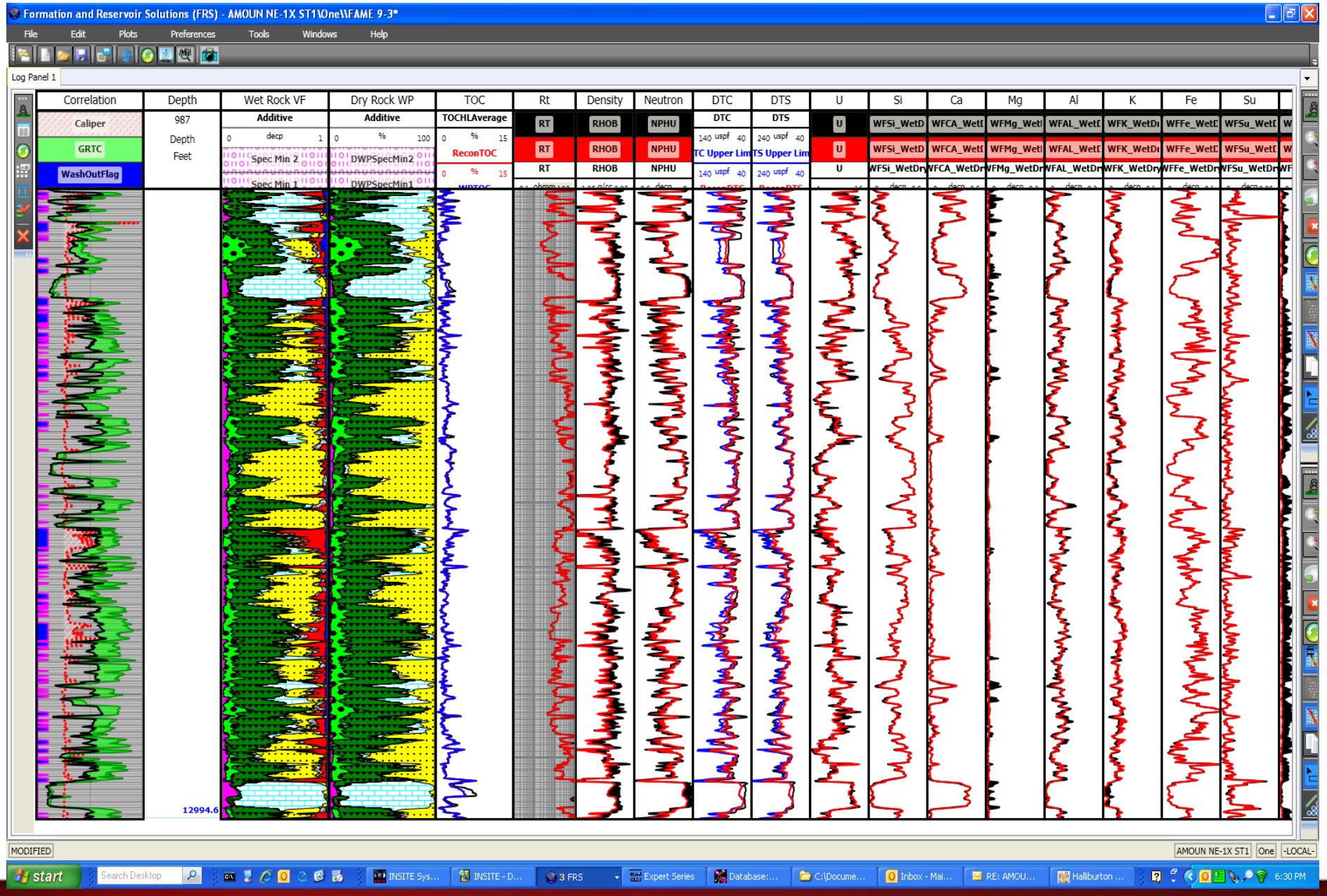
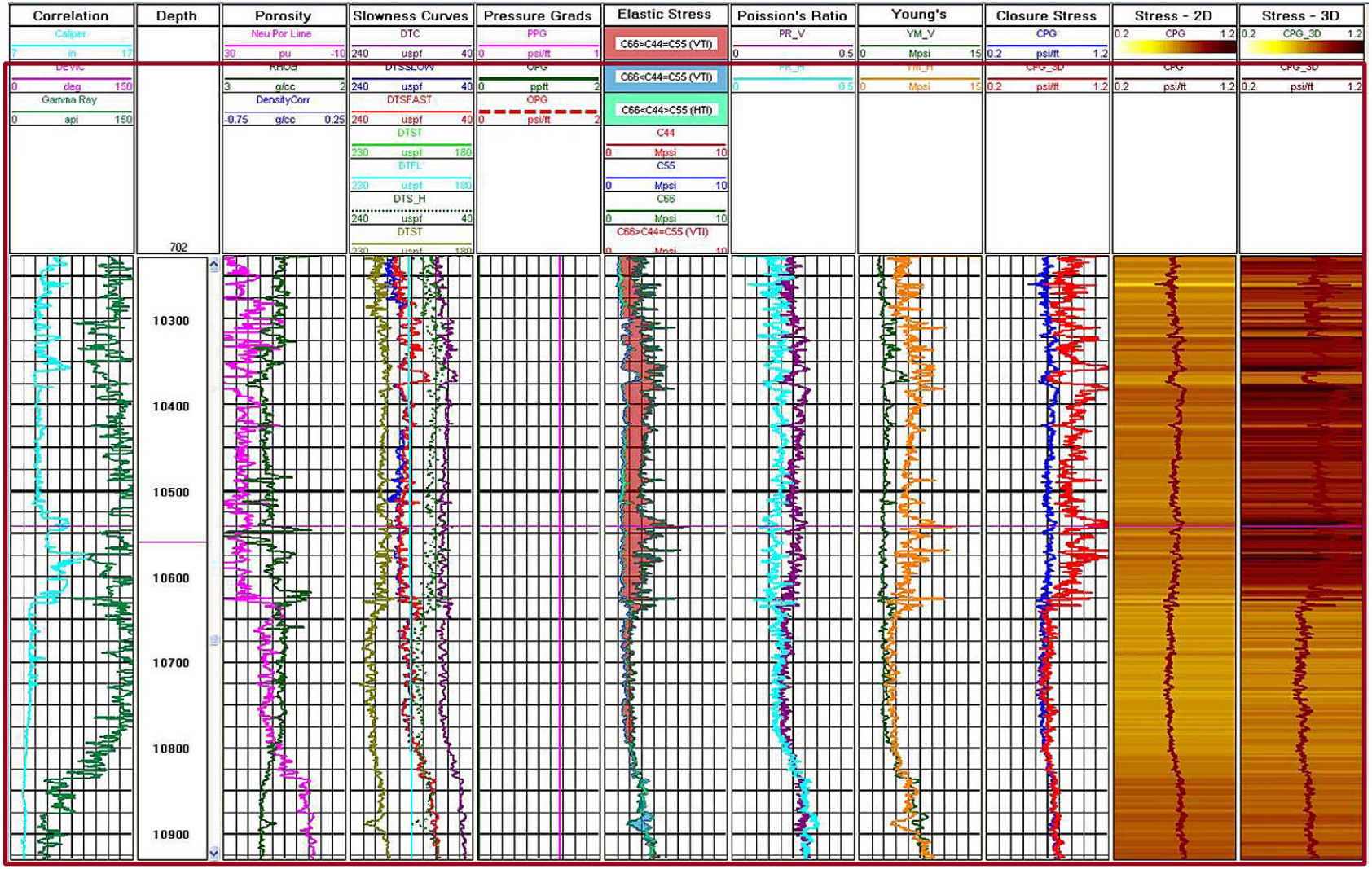
Comprehensive Petrophysical Analysis



Three Dimensional Stress Analysis for Stimulation



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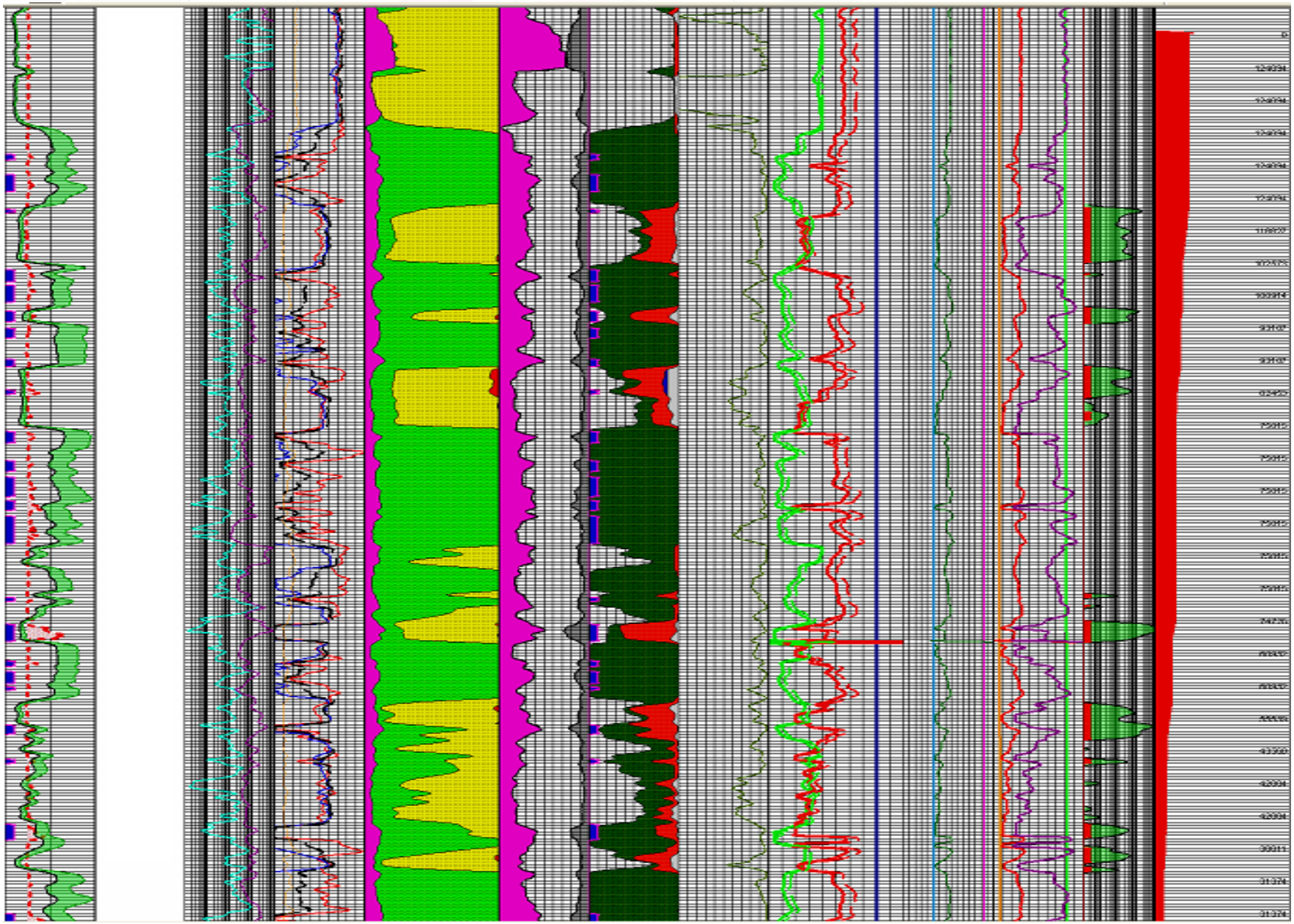
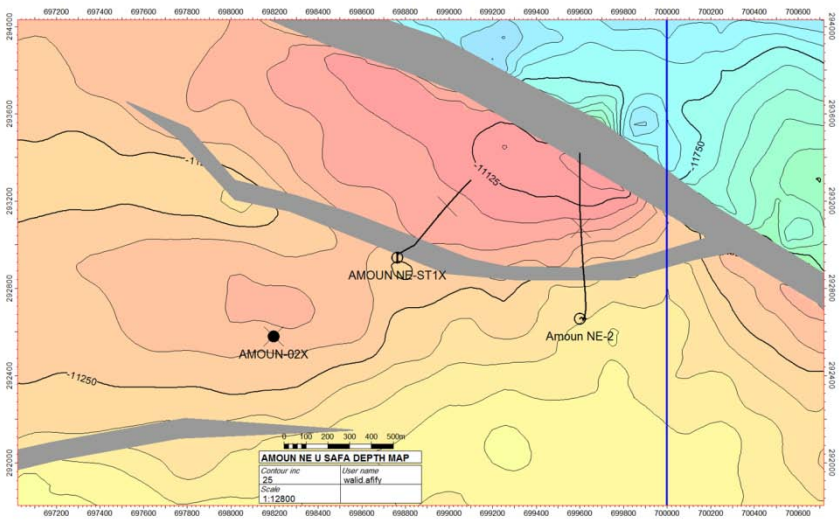
Production Estimate

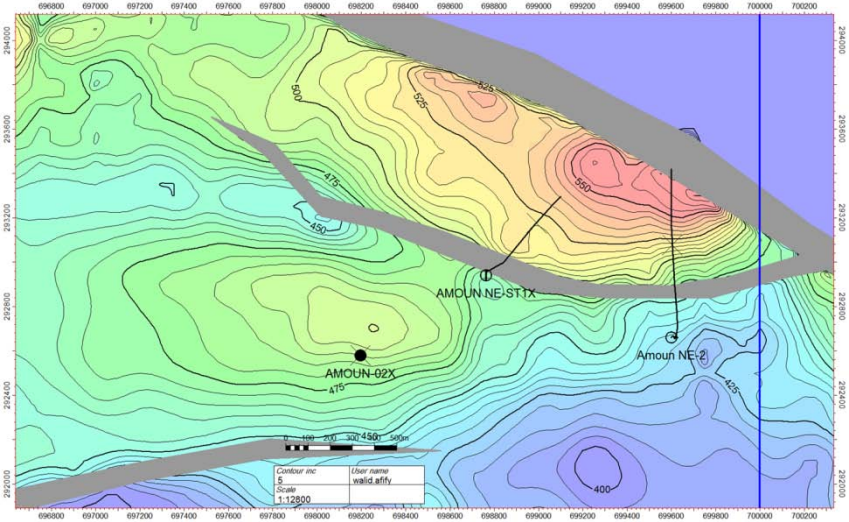


On going work

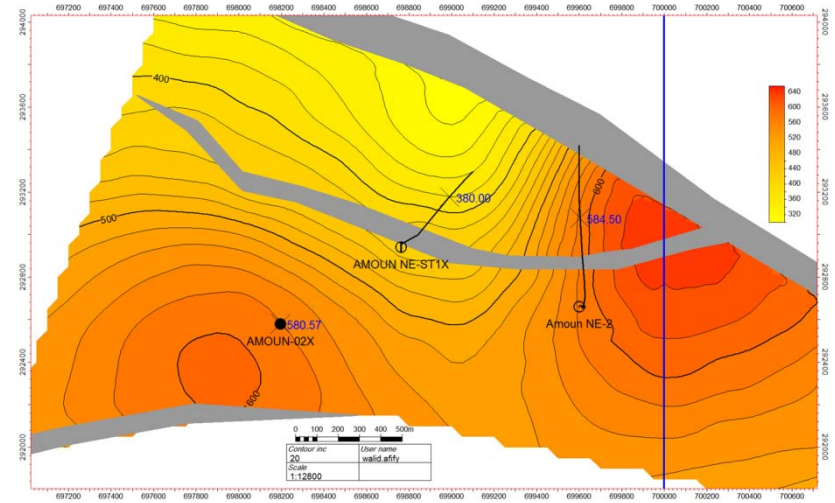
Structure



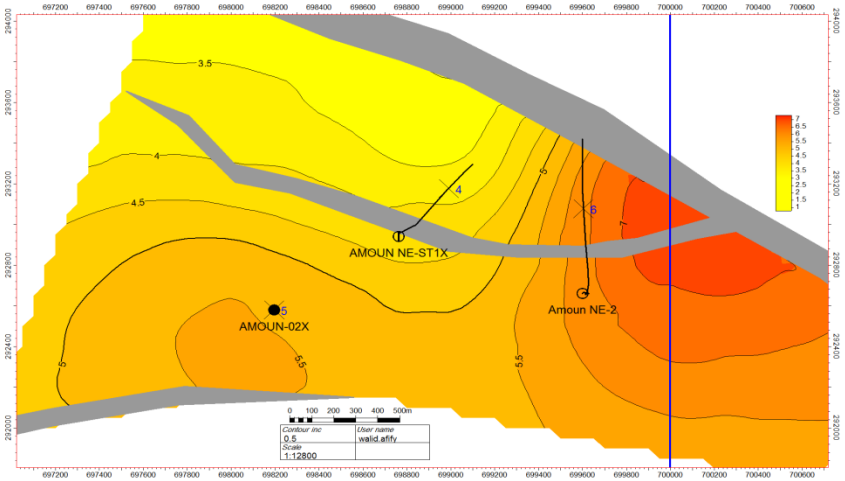
Iso-Patch



Shale Thickness



TOC Map



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Conclusions

- It is vital to investigate the correctness of the published reserve numbers on local basis
- It is of practical reasons to use existing core and logging data and P&A wells in the early stages of evaluation
- It is low cost and of great value to acquire information on shale plays during the conventional drilling if the wells penetrate the shale zones
- All tools for investigation and identification of shale plays exist in the region

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